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Iguchi

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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS WITH TEMPERATURE CONTROL**

(71) Applicants: **KABUSHIKI KAISHA TOSHIBA**, Tokyo (JP); **TOSHIBA TEC KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventor: **Ken Iguchi**, Numazu Shizuoka (JP)

(73) Assignees: **KABUSH1 Kl KAISHA TOSHIBA**, Tokyo (JP); **TOSHIBA TEC KABUSHIKI KAISHA**, Tokyo (JP)

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This patent is subject to a terminal disclaimer.

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(Continued)

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G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/2039*** (2013.01); ***G03G 15/2017*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/2039; G03G 15/2032; G03G 15/2035; G03G 15/205

(Continued)

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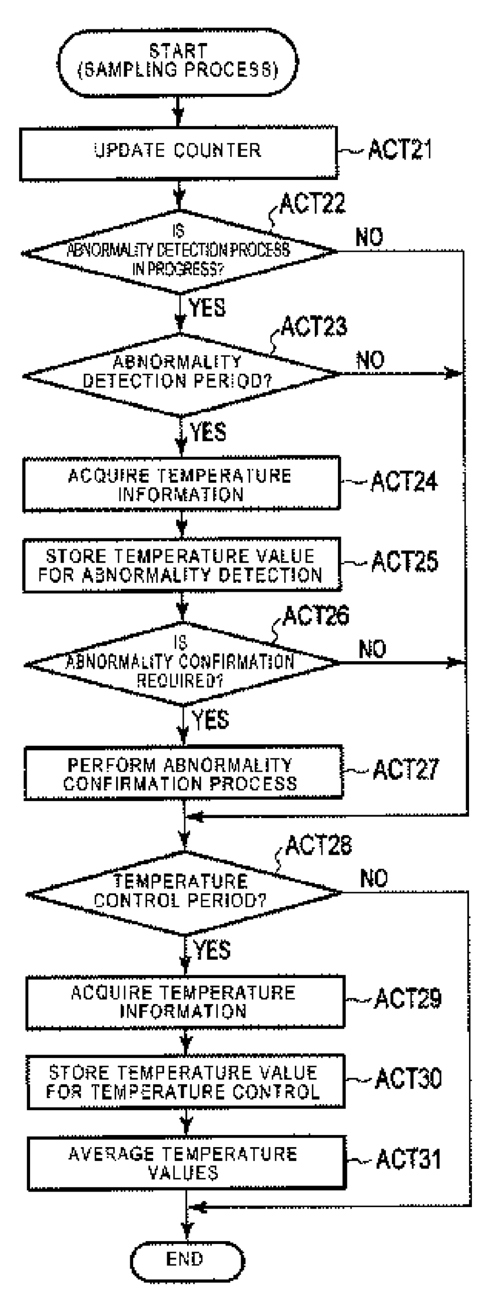
Primary Examiner — William J Royer

(74) *Attorney, Agent, or Firm* — Amin, Turocy & Watson, LLP

(57) **ABSTRACT**

A fixing unit includes a heater, a fixing member, a press roller, a sensor, a processor, and a memory. The fixing member is heated by heat generated by the heater. The press roller forms a nip portion through which a medium having a fixing target material transferred thereto passes, between the press roller and the fixing member. The sensor measures a temperature of the fixing member. The processor controls the temperature of the fixing member so as to be a target value by acquiring the temperature detected by the sensor in a first period, and also acquires the temperature detected by the sensor in a second period shorter than the first period. The memory records the temperature acquired in the second period.

20 Claims, 11 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/935,121, filed on Mar. 26, 2018, now Pat. No. 10,496,020.

(58) **Field of Classification Search**
USPC 399/33, 69, 122
See application file for complete search history.

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FIG. 1

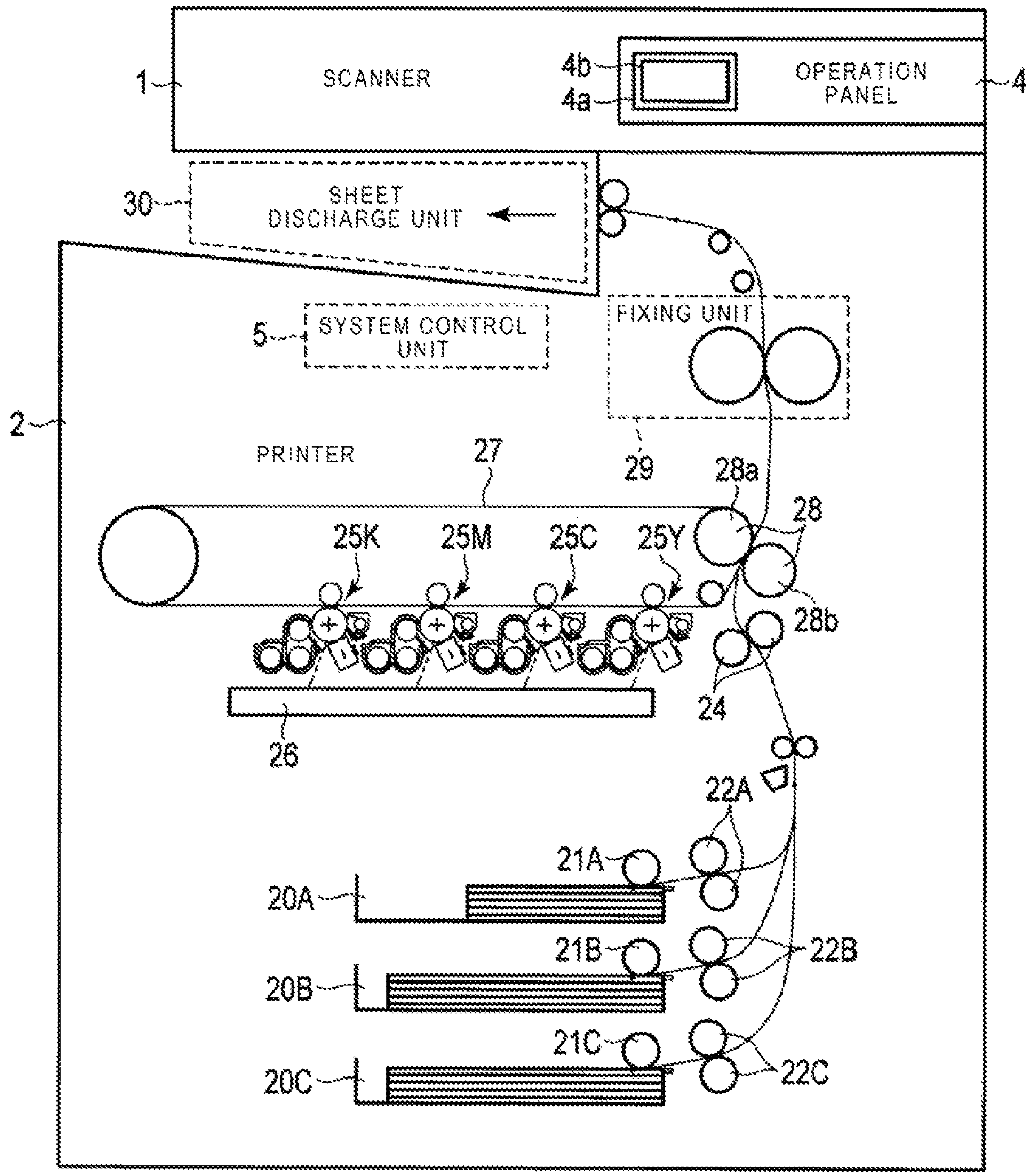
SCANNER
1
4b
4a
OPERATION PANEL
4
30
SHEET DISCHARGE UNIT
5
SYSTEM CONTROL UNIT
FIXING UNIT
2
PRINTER
27
29
28a
28
25K
25M
25C
25Y
28b
24
26
22A
21A
20A
21B
22B
20B
21C
20C
22C

FIG. 2

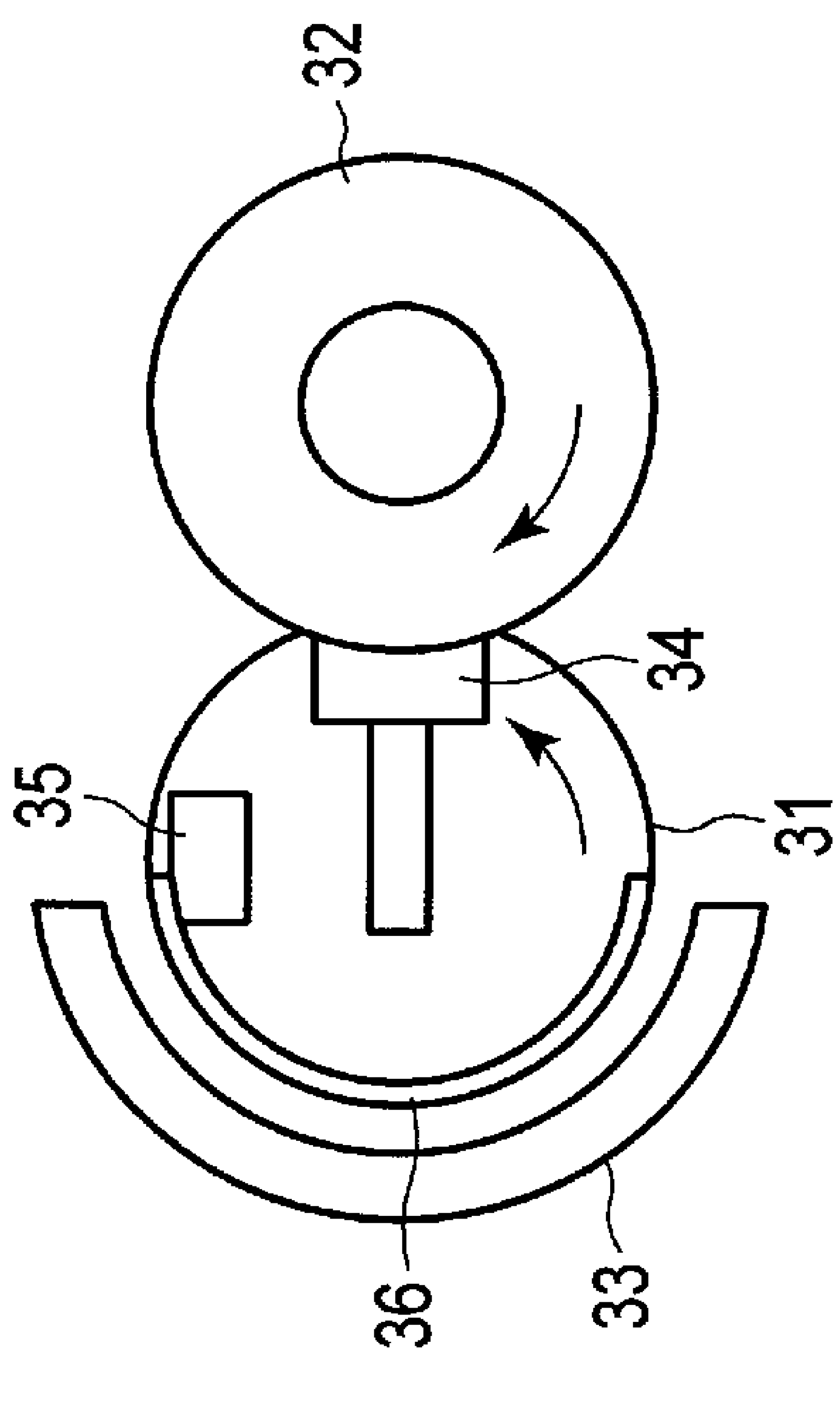

FIG. 3

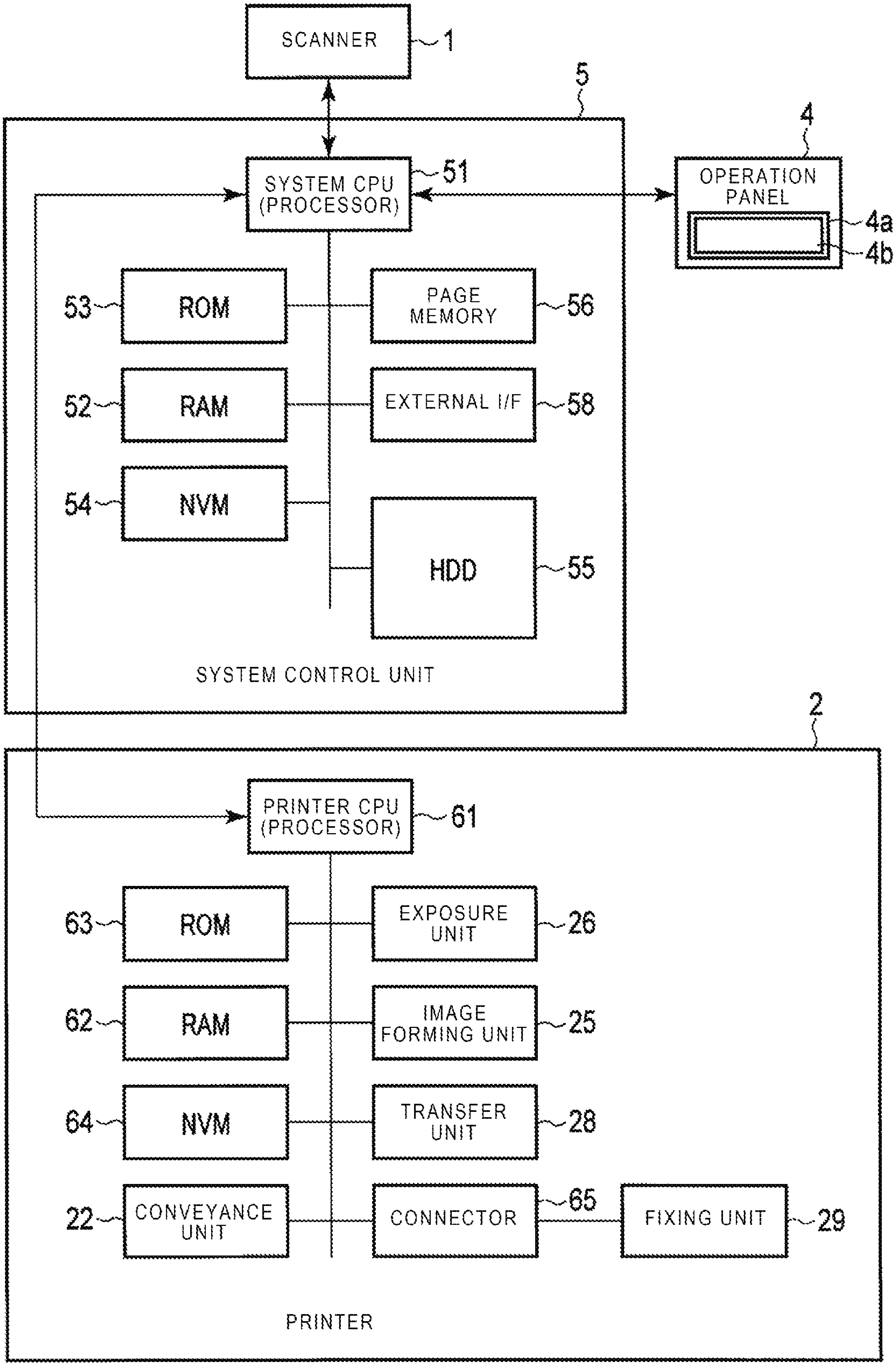
SCANNER
1
5
4
OPERATION PANEL
4a
4b
SYSTEM CPU (PROCESSOR)
51
53
ROM
PAGE MEMORY
56
52
RAM
EXTERNAL I/F
58
54
NVM
HDD
55
SYSTEM CONTROL UNIT
2
PRINTER CPU (PROCESSOR)
61
63
ROM
EXPOSURE UNIT
26
62
RAM
IMAGE FORMING UNIT
25
64
NVM
TRANSFER UNIT
28
22
CONVEYANCE UNIT
CONNECTOR
65
FIXING UNIT
29
PRINTER

FIG. 4

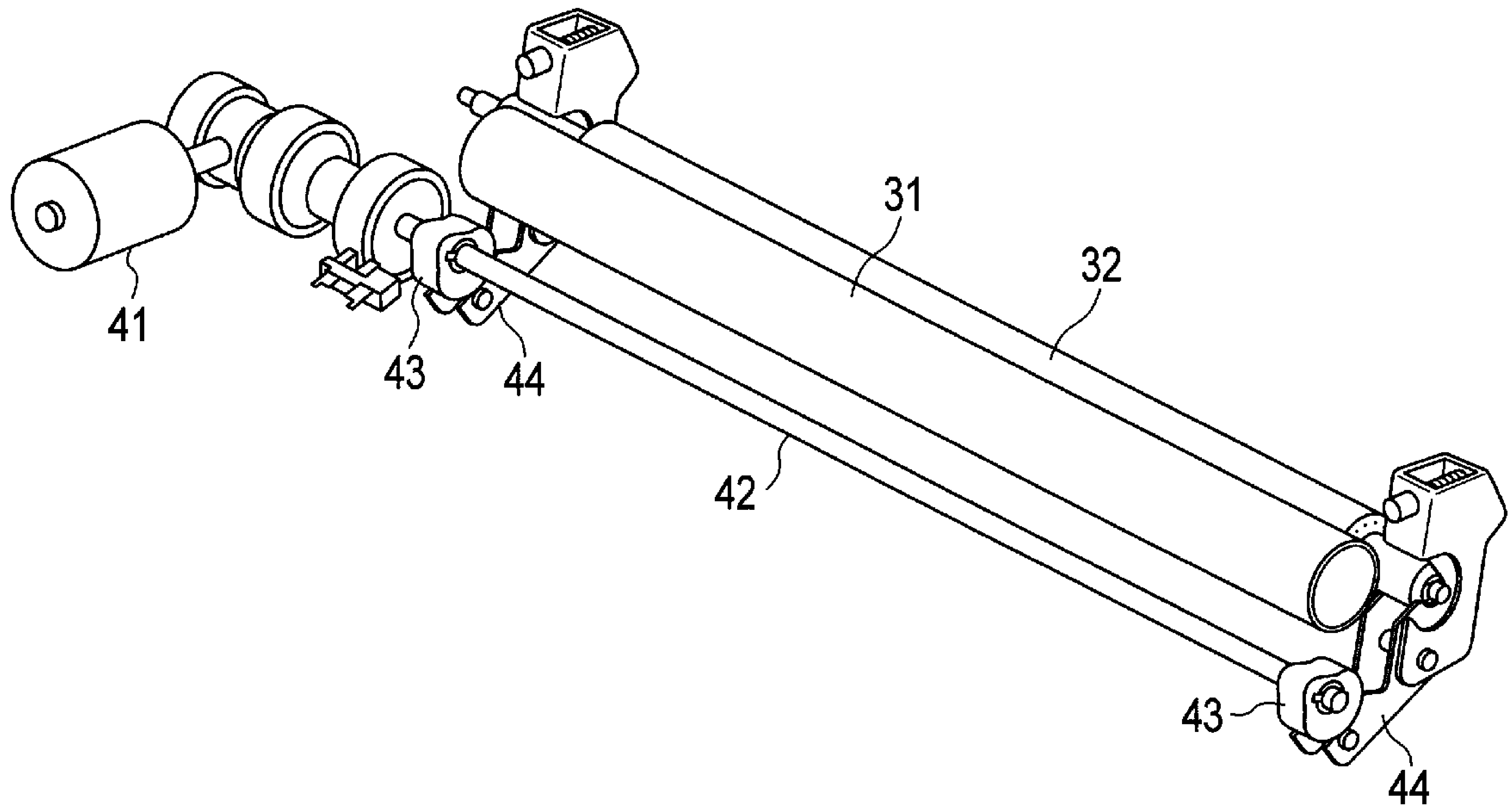

FIG. 5

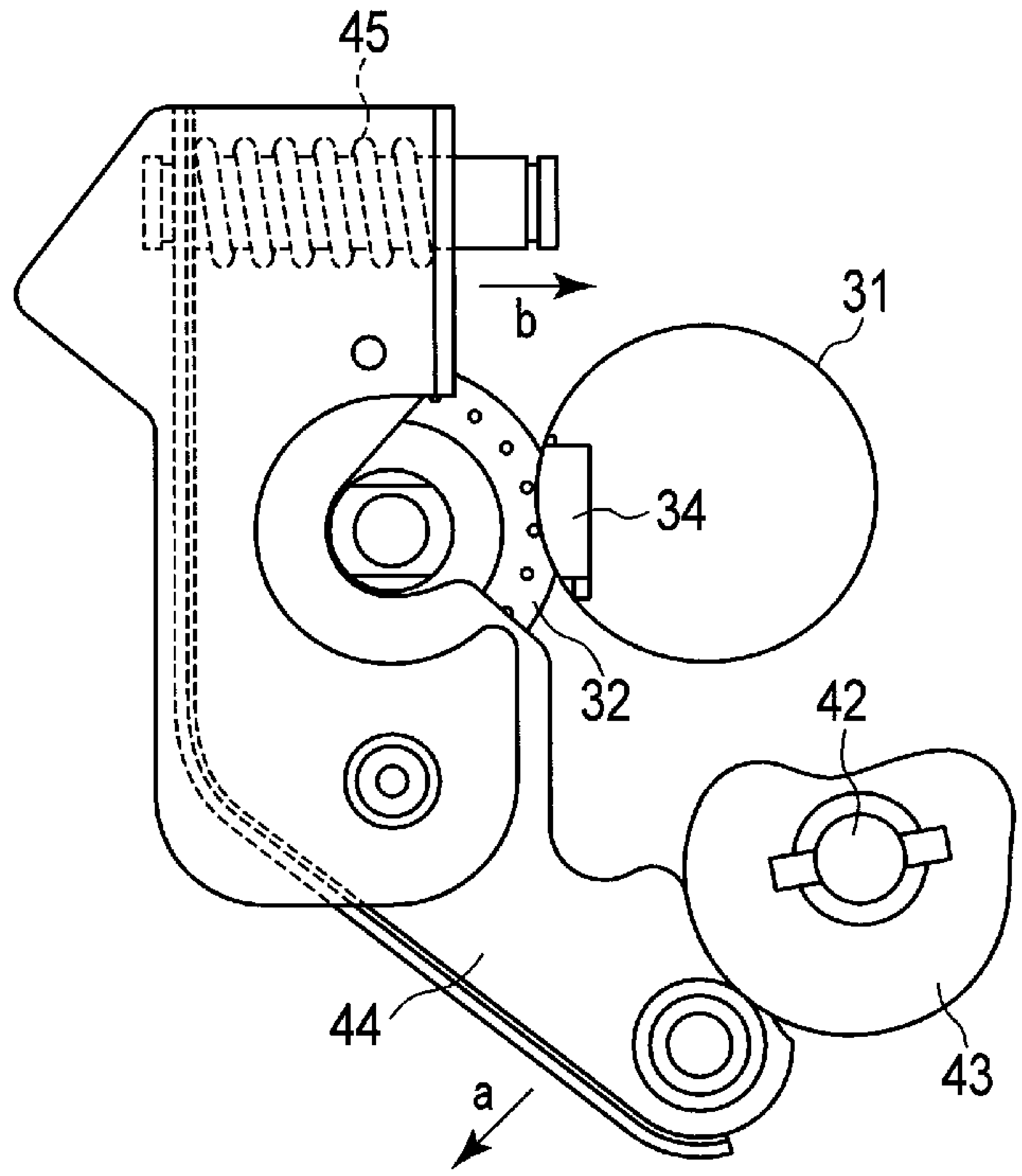

FIG. 6

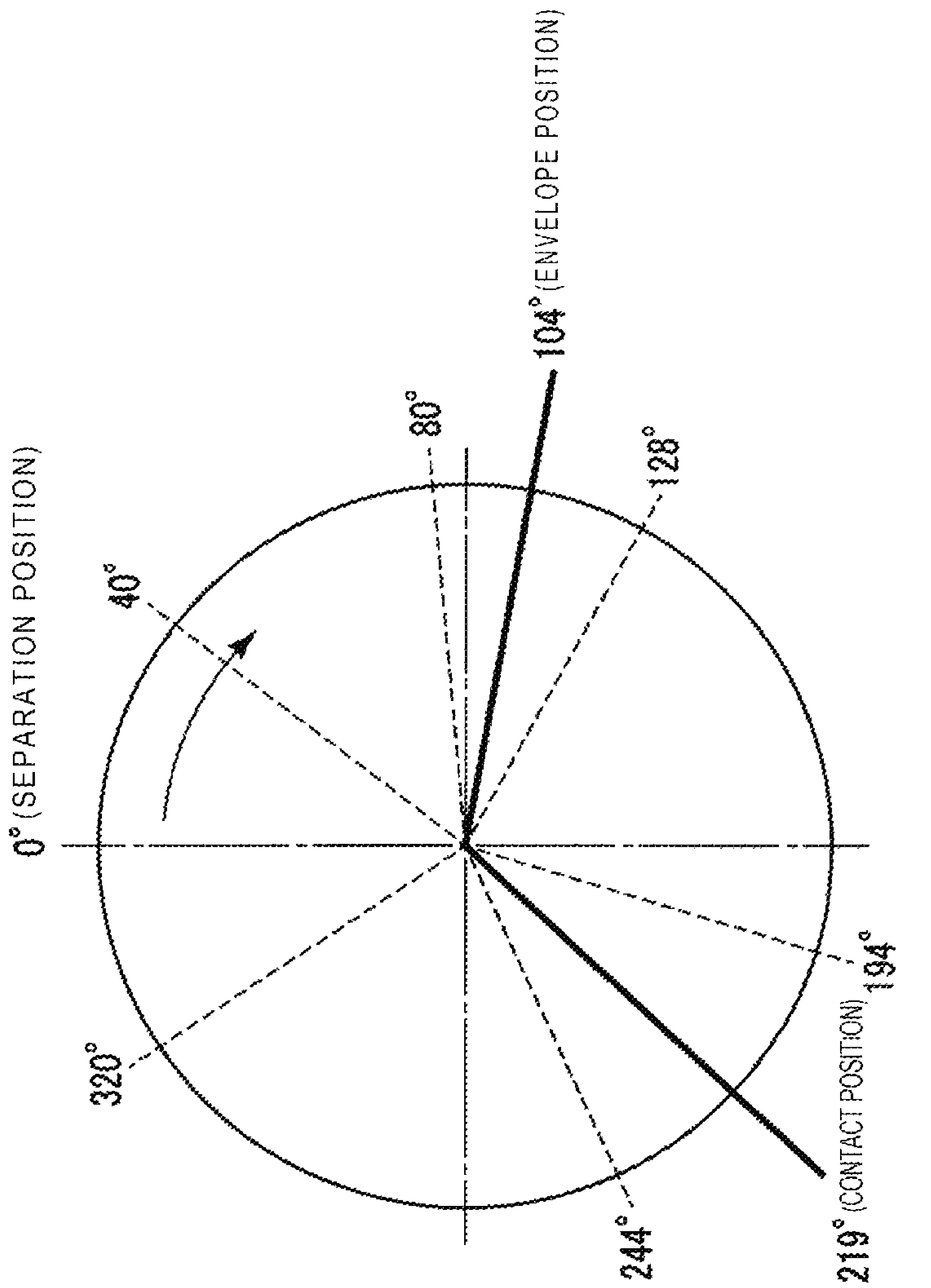
0° (SEPARATION POSITION)
40°
80°
104° (ENVELOPE POSITION)
128°
194°
219° (CONTACT POSITION)
244°
320°

FIG. 7

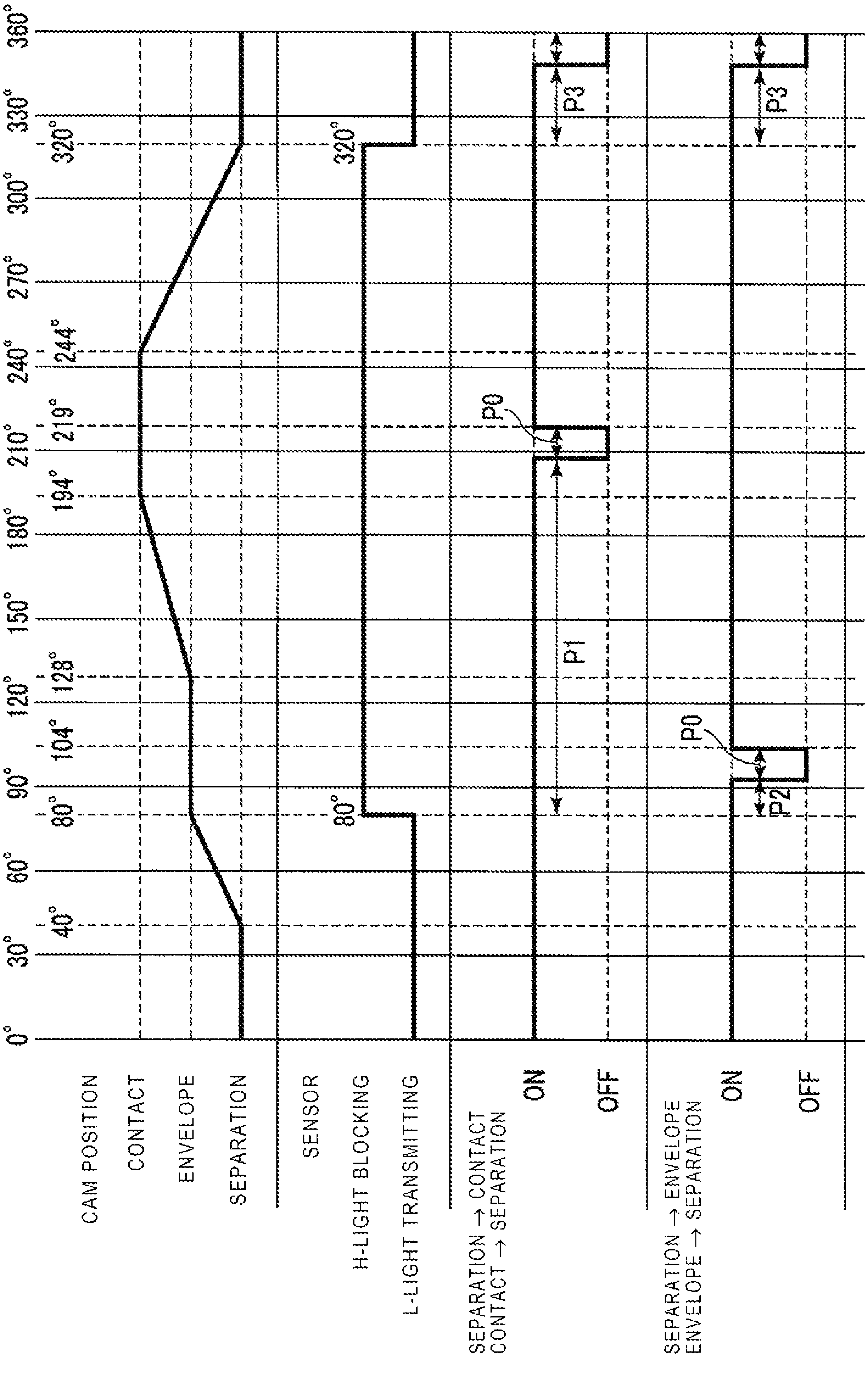
CAM POSITION
CONTACT
ENVELOPE
SEPARATION
SENSOR
H-LIGHT BLOCKING
L-LIGHT TRANSMITTING
SEPARATION → CONTACT
CONTACT → SEPARATION
ON
OFF
SEPARATION → ENVELOPE
ENVELOPE → SEPARATION
ON
OFF
0°
30°
40°
60°
80°
90°
104°
120°
128°
150°
180°
194°
210°
219°
240°
244°
270°
300°
320°
330°
360°
P0
P1
P2
P3

FIG. 8

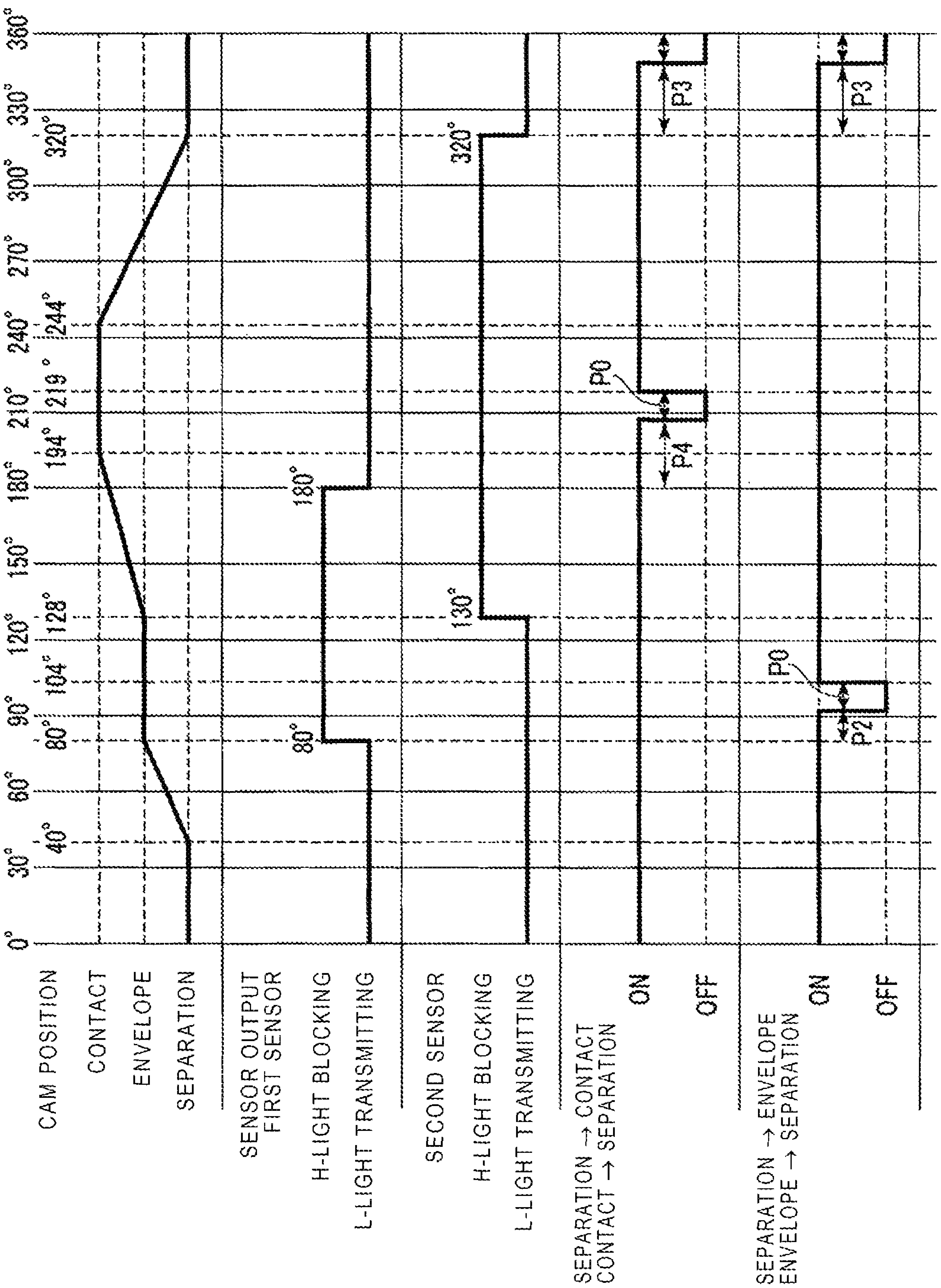
CAM POSITION
CONTACT
ENVELOPE
SEPARATION
SENSOR OUTPUT
FIRST SENSOR
H-LIGHT BLOCKING
L-LIGHT TRANSMITTING
SECOND SENSOR
H-LIGHT BLOCKING
L-LIGHT TRANSMITTING
SEPARATION → CONTACT
CONTACT → SEPARATION
ON
OFF
SEPARATION → ENVELOPE
ENVELOPE → SEPARATION
ON
OFF
0°
30°
40°
60°
80°
90°
104°
120°
128°
150°
180°
194°
210°
219°
240°
244°
270°
300°
320°
330°
360°
80°
180°
130°
320°
P0
P4
P3
P0
P2
P3

FIG. 9

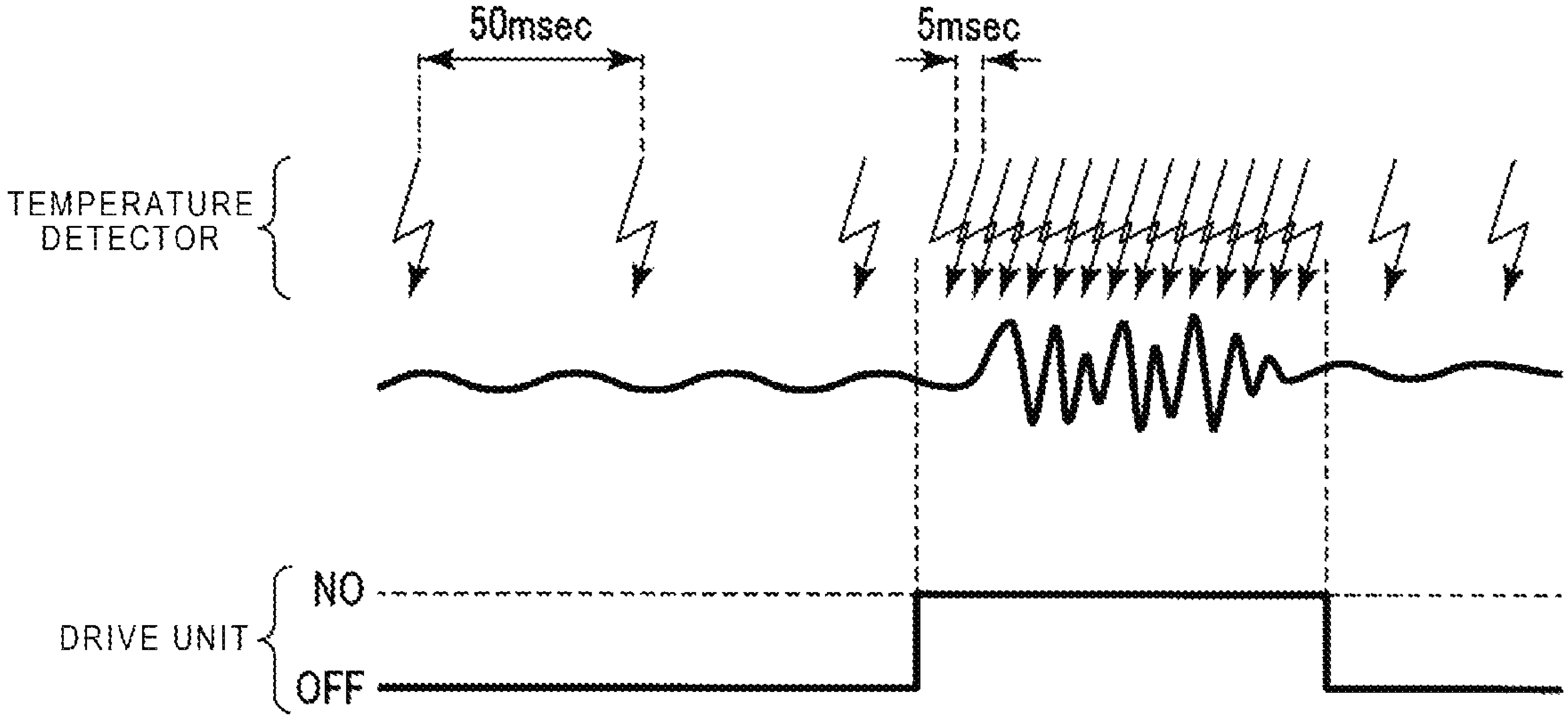
50msec
5msec
TEMPERATURE DETECTOR
DRIVE UNIT
NO
OFF

FIG. 10

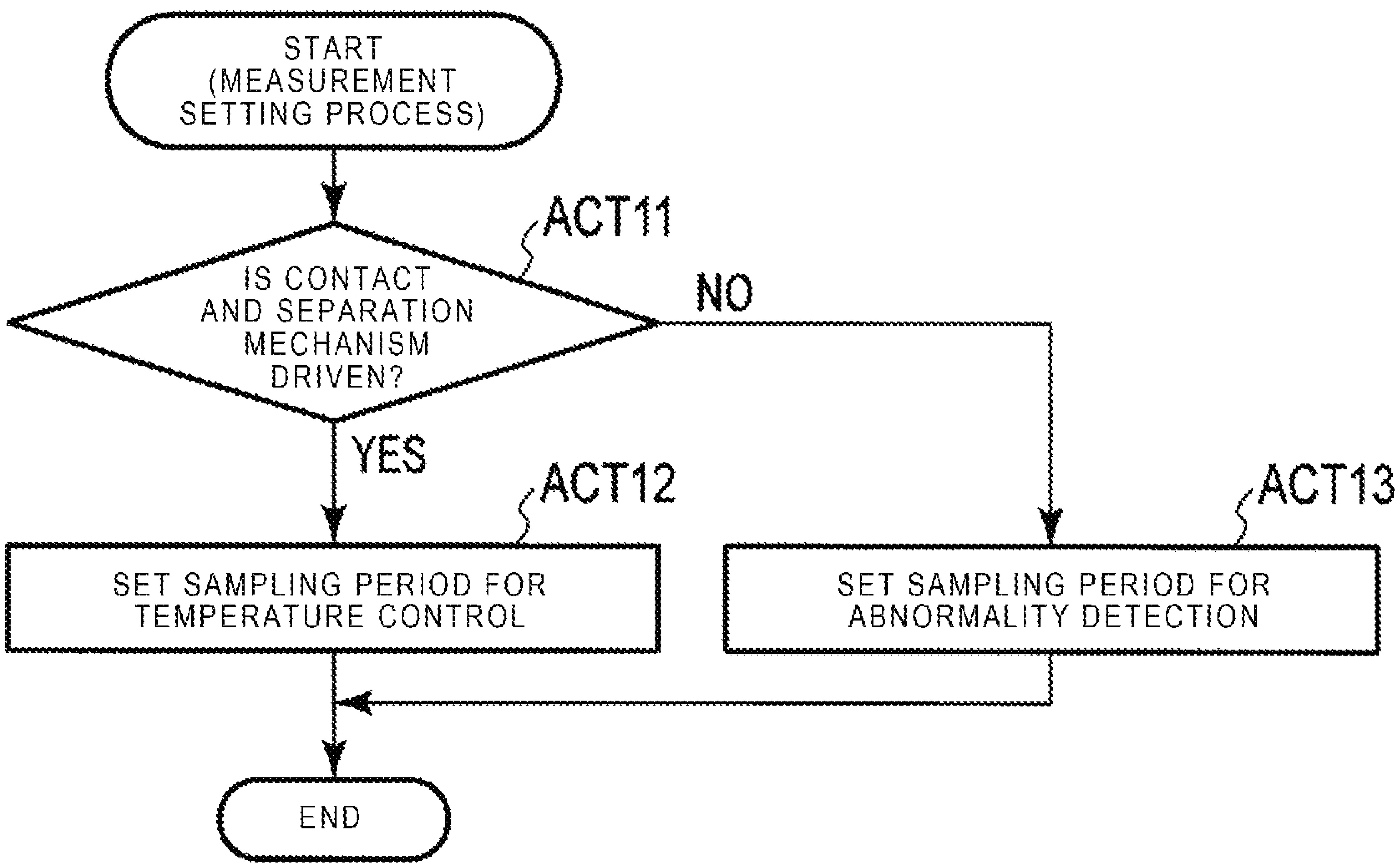
START (MEASUREMENT SETTING PROCESS)
ACT11
IS CONTACT AND SEPARATION MECHANISM DRIVEN?
NO
YES
ACT12
ACT13
SET SAMPLING PERIOD FOR TEMPERATURE CONTROL
SET SAMPLING PERIOD FOR ABNORMALITY DETECTION
END

FIG. 11

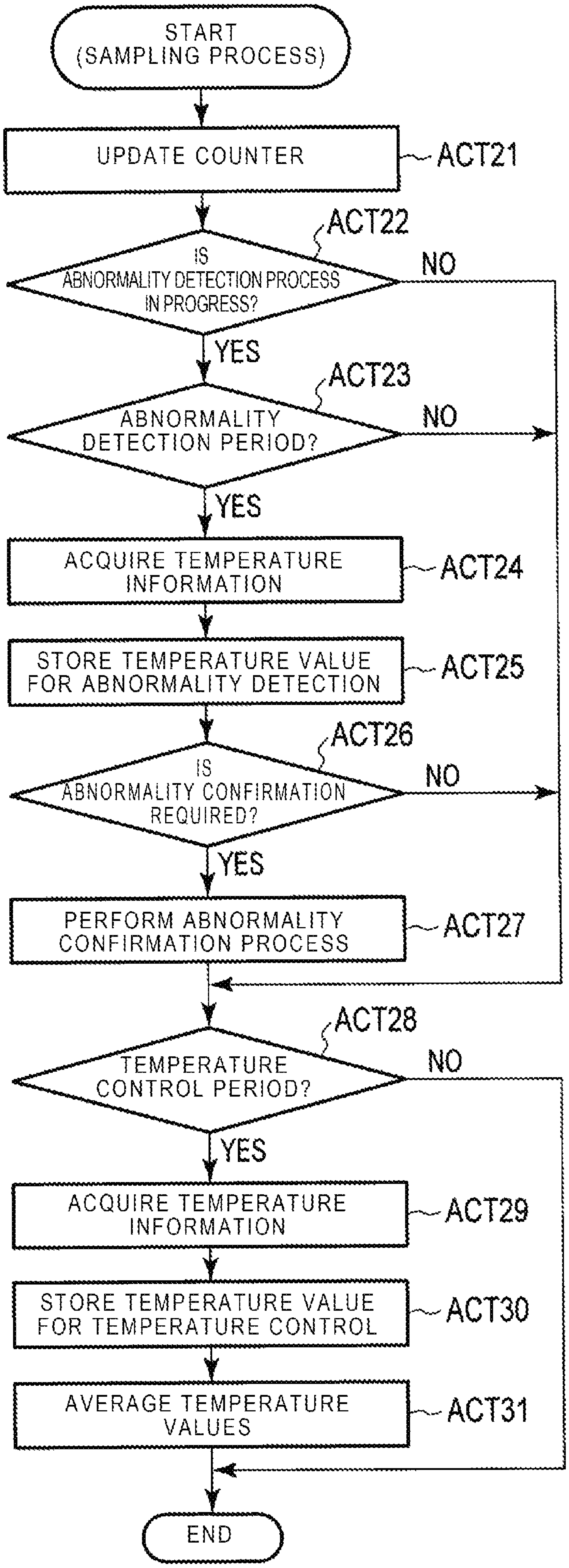
START
(SAMPLING PROCESS)
UPDATE COUNTER
ACT21
ACT22
IS
ABNORMALITY DETECTION PROCESS
IN PROGRESS?
NO
YES
ACT23
ABNORMALITY
DETECTION PERIOD?
NO
YES
ACQUIRE TEMPERATURE
INFORMATION
ACT24
STORE TEMPERATURE VALUE
FOR ABNORMALITY DETECTION
ACT25
ACT26
IS
ABNORMALITY CONFIRMATION
REQUIRED?
NO
YES
PERFORM ABNORMALITY
CONFIRMATION PROCESS
ACT27
ACT28
TEMPERATURE
CONTROL PERIOD?
NO
YES
ACQUIRE TEMPERATURE
INFORMATION
ACT29
STORE TEMPERATURE VALUE
FOR TEMPERATURE CONTROL
ACT30
AVERAGE TEMPERATURE
VALUES
ACT31
END

FIG. 12

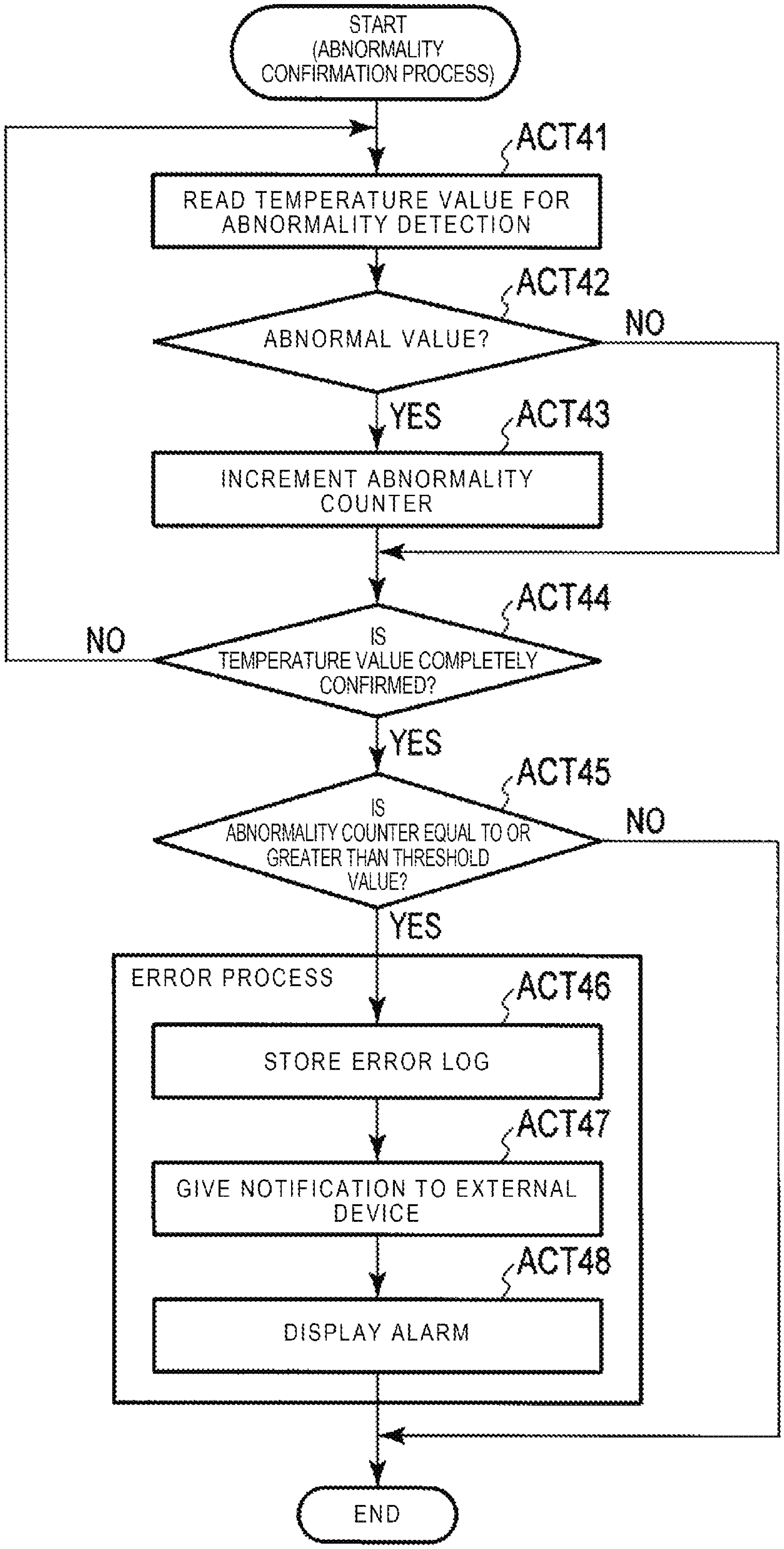
START
(ABNORMALITY
CONFIRMATION PROCESS)
ACT41
READ TEMPERATURE VALUE FOR ABNORMALITY DETECTION
ACT42
ABNORMAL VALUE?
NO
YES
ACT43
INCREMENT ABNORMALITY COUNTER
ACT44
IS TEMPERATURE VALUE COMPLETELY CONFIRMED?
NO
YES
ACT45
IS ABNORMALITY COUNTER EQUAL TO OR GREATER THAN THRESHOLD VALUE?
NO
YES
ERROR PROCESS
ACT46
STORE ERROR LOG
ACT47
GIVE NOTIFICATION TO EXTERNAL DEVICE
ACT48
DISPLAY ALARM
END

FIG. 13

150°C
147°C
147°C
144°C
153°C
148°C
165°C
136°C
151°C
149°C

FIXING DEVICE AND IMAGE FORMING APPARATUS WITH TEMPERATURE CONTROL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of application Ser. No. 16/668,438 filed on Oct. 30, 2019, which is a Continuation of application Ser. No. 15/935,121 filed on Mar. 26, 2018, the entire contents of both of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to a fixing unit, an image forming apparatus, and methods associated therewith.

BACKGROUND

An image forming apparatus using an electrophotographic system such as a multi-functional peripheral has a fixing unit including a heating device. The fixing unit controls a heat source in accordance with a temperature detected by a temperature detector such as a thermistor. The fixing unit is unitized and installed inside the image forming apparatus such as the multi-functional peripheral. The fixing unit is typically a heavy unit. Consequently, due to vibrations, an extremely heavy load is applied to a connector serving as a harness connecting portion connected to the image forming apparatus, thereby causing a possibility of trouble.

In a fixing process, the fixing unit performs temperature control for controlling a preset fixing temperature, based on the temperature detected by the temperature detector. In a usual fixing process, the fixing unit performs the temperature control by averaging detected temperatures so as to remove noise output by the temperature detector. Therefore, the fixing unit in the related art has a problem in that a sudden abnormal change in the temperature cannot be detected.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view schematically illustrating a configuration example of a multi-functional peripheral according to an embodiment.

FIG. **2** is a sectional view illustrating a configuration example of a fixing unit.

FIG. **3** is a block diagram schematically illustrating a configuration example of a control system in the multi-functional peripheral.

FIG. **4** is a perspective view schematically illustrating a configuration example of the fixing unit.

FIG. **5** is a view for describing a configuration example of a contact and separation mechanism in the fixing unit.

FIG. **6** is a view illustrating an example of a relationship between a rotation angle of an eccentric cam and a position of a press roller in the fixing unit.

FIG. **7** is a timing chart for describing an operation of each unit in a fixing process of the fixing unit.

FIG. **8** is a timing chart for describing an operation of each unit in a fixing process of the fixing unit.

FIG. **9** is a view for describing an operation example of temperature measurement in a fixing process and an abnormality detection process of the fixing unit.

FIG. **10** is a flowchart for describing a setting process (measurement setting process) of a sampling period for setting the timing of measuring temperature of the fixing unit.

FIG. **11** is a flowchart for describing a sampling process (temperature measurement process) for measuring the temperature of the fixing unit.

FIG. **12** is a flowchart for describing an operation example of an abnormality confirmation process for the fixing unit.

FIG. **13** is a view illustrating an example of abnormality detecting temperature values stored in an abnormality detecting buffer in the abnormality detection process of the fixing unit.

DETAILED DESCRIPTION

According to an embodiment, a fixing unit includes a heater, a fixing member, a press roller, a sensor, a processor, and a memory. The fixing member is heated by heat generated by the heater. The press roller forms, between the press roller and the fixing member a nip portion through which a medium having a fixing target material transferred thereto passes. The sensor measures temperature of the fixing member. The processor acquires the temperature detected by the sensor in a first period, controls the temperature of the fixing member so as to be a target value, and also acquires the temperature detected by the sensor in a second period which is shorter than the first period. The memory records the temperature acquired in the second period.

Hereinafter, an embodiment will be described with reference to the drawings.

FIG. **1** is a sectional view schematically illustrating a configuration example of a multi-functional peripheral according to the embodiment.

As illustrated in FIG. **1**, the multi-functional peripheral (MFP) according to the embodiment described herein includes a scanner **1**, a printer **2**, an operation panel **4**, and a system control unit **5**.

The scanner **1** is a device which reads an image of an original document, and converts the image into image data. For example, the scanner **1** is configured to include a CCD line sensor which converts the image on a reading surface of the original document into the image data. The scanner **1** may scan the original document placed on original document table glass, or may read the image of the original document conveyed by an auto document feeder (ADF). The scanner **1** is controlled by the system control unit **5**. The scanner **1** outputs the image data of the original document to the system control unit **5**.

The printer **2** forms the image on a sheet serving as a medium (an image forming medium or a printing medium). The printer **2** is an electrophotographic image forming apparatus for forming the image by using toner serving as an image forming material. In a configuration example illustrated in FIG. **1**, the printer **2** has a color printing function to print a color image on the sheet and a monochrome printing function to print a monochrome (for example, black) image on the sheet. The printer **2** forms the color image by using toners having a plurality of colors (for example, three colors of yellow (Y), cyan (C), and magenta (M)). In addition, the printer **2** forms the monochrome image by using a monochrome (for example, black) toner.

The printer **2** has sheet feeding cassettes **20** (**20**A, **20**B, and **20**C). The sheet feeding cassette **20** supplies a printing medium such as sheets or envelopes on which the image is printed. In addition, the printer **2** may have a manual feeding tray as a sheet feeding unit for supplying the printing medium. For example, each of the sheet feeding cassettes **20**A, **20**B, and **20**C in a detachable state is disposed in a lower portion of a main body of the multi-functional peripheral. These sheet feeding cassettes **20**A, **20**B, and **20**C accommodate the printing medium having respectively preset types (for example, a size, sheet quality, and a thickness).

The sheet feeding cassettes **20**A, **20**B, and **20**C have pickup rollers **21** (**21**A, **21**B, and **21**C), respectively. The pickup rollers **21**A, **21**B, and **21**C pick up the printing medium one by one from the respective sheet feeding cassettes **20**A, **20**B, and **20**C. The pickup rollers **21**A, **21**B, and **21**C supply the picked-up printing medium to a conveyance path (conveyance unit) **22** configured to include a plurality of conveyance rollers **22**A, **22**B, and **22**C. The number of the sheet feeding cassettes and the pickup rollers which serve as a sheet feeding unit is not limited to three.

The conveyance unit **22** conveys the printing medium inside the printer **2**. The conveyance unit **22** conveys the printing medium supplied by the pickup rollers **21**A, **21**B, and **21**C to a registration roller **24**. At the timing of transferring the image from an intermediate transfer belt **27** to the printing medium, the registration roller **24** conveys the printing medium to a transfer position of the printing medium.

Image forming units **25** (**25**Y, **25**M, **25**C, and **25**K), an exposure unit **26**, the intermediate transfer belt **27**, and a transfer unit **28** form an image. The image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) form the image to be transferred to the printing medium. In a configuration example illustrated in FIG. **1**, the image forming unit **25**Y forms the image with yellow toner. The image forming unit **25**M forms the image with magenta toner. The image forming unit **25**C forms the image with cyan toner. The image forming unit **25**K forms the image with black toner. The image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) superimposedly transfer the images having respective colors on the intermediate transfer belt **27**. In this manner, the color image is formed on the intermediate transfer belt **27**.

The exposure unit **26** forms an electrostatic latent image on a photoconductive drum (image carrier) of each of the image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) by using laser light. The exposure unit **26** irradiates the photoconductive drum with the laser light controlled in accordance with the image data via an optical system such as a polygon mirror. The laser light from the exposure unit **26** forms the electrostatic latent image on a surface of each photoconductive drum. The exposure unit **26** controls the laser light in accordance with a control signal output from the system control unit **5**. The electrostatic latent image formed in each photoconductive drum is the image to be developed using the toner of each color.

Each of the image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) develops the electrostatic latent image formed on each photoconductive drum with the toner of each color. Each of the image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) forms a toner image as a visible image on the photoconductive drum. The intermediate transfer belt **27** is an intermediate transfer member. Each of the image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) transfers (primarily transfers) the toner image formed on the photoconductive drum onto the intermediate transfer belt **27**. Each of the image forming units **25** (**25**Y, **25**M, **25**C, and **25**K) applies a transfer bias to the toner image at a primary transfer position. The toner image on each photoconductive drum is transferred to the intermediate transfer belt **27** by the transfer bias at each primary transfer position.

For example, when the monochrome image is formed, the image forming unit **25**K transfers (primarily transfers) the toner image (visible image) developed with the black (monochrome) toner onto the intermediate transfer belt **27**. As a result, the intermediate transfer belt **27** holds the monochrome image formed with the black (monochrome) toner.

In addition, when the color image is formed, each of the image forming units **25**Y, **25**M, **25**C, and **25**K superimposedly transfers (primarily transfer) the toner image (visible image) developed with the toner of each color (yellow, magenta, cyan, and black) onto the intermediate transfer belt **27**. As a result, the intermediate transfer belt **27** holds the color image in which the toner images having respective colors overlap each other.

The transfer unit **28** transfers the toner image formed on the intermediate transfer belt **27** to the printing medium such as the sheet or the envelope at a secondary transfer position. The secondary transfer position means a position where the toner image formed on the intermediate transfer belt **27** is to be transferred to the printing medium. The secondary transfer position means a position where a support roller **28***a* and a secondary transfer roller **28***b* face each other. The transfer unit **28** applies the transfer bias controlled by a transfer current to the secondary transfer position. The transfer unit **28** transfers the toner image formed on the intermediate transfer belt **27** (a decolorized toner image or a normal toner image) to the printing medium by using the transfer bias. The system control unit **5** controls the transfer current used for a secondary transfer process. For example, the system control unit **5** may control each of the transfer current when the decolorized toner image is transferred and the transfer current when the normal toner image is transferred.

A fixing unit **29** fixes the toner to the printing medium such as the sheet or the envelope. The fixing unit **29** applies heat to the printing medium to which the toner is transferred in a pressurized state, in order to perform a fixing process of fixing the toner image onto the sheet. The system control unit **5** controls the fixing unit **29** to have a fixing temperature when a fixing process is performed to fix the toner image onto the printing medium. The fixing unit **29** controlled to have the fixing temperature pressurizes and heats the printing medium having the toner image transferred by the transfer unit **28** at the fixing temperature. In this manner, the fixing unit **29** fixes the toner image onto the printing medium. In addition, the fixing unit **29** conveys the printing medium subjected to the fixing process to a sheet discharge unit **30**. The sheet discharge unit **30** discharges the sheet subjected to the fixing process by the fixing unit **29** to a predetermined position outside the printer **2**.

A configuration of the fixing unit **29** will be described in detail later. In addition, a configuration for forming the toner image on the printing medium such as the sheet or the envelope is not limited to the above-described configuration. The image forming apparatus according to the embodiment described herein may have any configuration where the printing medium serving as a target of the fixing process is supplied to the fixing unit **29**.

The operation panel **4** is a user interface. The operation panel **4** has various buttons and a display unit **4***a* provided with a touch panel **4***b*. The system control unit **5** controls content displayed on the display unit **4***a* of the operation panel **4**. In addition, the operation panel **4** outputs information input from the touch panel **4***b* of the display unit **4***a* or the buttons to the system control unit **5**. A user designates an operation mode on the operation panel **4**, or inputs information such as setting information.

Next, a configuration of the fixing unit (fixing device) **29** disposed in the multi-functional peripheral according to the embodiment will be described.

FIG. **2** is a sectional view illustrating a configuration example of the fixing unit **29** according to the embodiment.

In the configuration example illustrated in FIG. **2**, the fixing unit **29** has a fixing belt (fixing member) **31**, a press roller (pressure contact member) **32**, a heating unit (heater) **33**, a fixing pad **34**, a temperature detector (sensor) **35**, and a magnetic shunt metal **36**. The fixing unit **29** is formed as one unit (fixing device). In addition, the fixing unit **29** has a connector serving as a harness connecting portion, and is connected to the multi-functional peripheral via the connector.

The fixing belt **31** is an endless belt. The fixing belt **31** is heated by the heat supplied from the heating unit **33**. The fixing belt **31** is formed of a material which has high thermal conductivity and which is easily deformable. For example, the fixing belt **31** includes a metal conductor and an elastic member. The fixing belt **31** may be the endless belt obtained in such a way that a metal layer formed of nickel, a solid rubber layer formed of silicone rubber, and a release layer formed of polytetrafluoroethylene (PFA) tube are sequentially stacked one on another.

The press roller **32** comes into contact with the fixing belt **31**. For example, the press roller **32** has a rubber layer around a cored bar. For example, the rubber layer serving as a surface of the press roller **32** is formed of silicone rubber or fluorine rubber.

The press roller **32** is moved in a direction where the press roller **32** comes into contact with or is separated from the fixing belt **31**, by a contact and separation mechanism (to be described later). A nip portion is formed between the fixing belt **31** and the press roller **32**. The printing medium is subjected to the fixing process by passing through the nip portion between the fixing belt **31** and the press roller **32**. Nipping pressure which is a pressure of the press roller **32** coming into contact with the fixing belt **31** is adjusted by the contact and separation mechanism.

An electromagnetic induction heater or a halogen lamp heater may be disposed in the press roller **32**. The heater is disposed in the press roller **32**, thereby further increasing a first copy output time (FCOT).

The heating unit **33**, the fixing pad **34**, the temperature detector **35**, and the magnetic shunt metal **36** are disposed in the vicinity of the fixing belt **31**. In a configuration example illustrated in FIG. **2**, the heating unit **33** is disposed on an outer periphery of the fixing belt **31**. In addition, the fixing pad **34**, the temperature detector **35**, and the magnetic shunt metal **36** are disposed inside the endless fixing belt **31**.

The heating unit **33** heats the fixing belt **31**. The heating unit **33** may be capable of controlling the temperature. For example, the heating unit **33** may be an induction heating (IH) type heater or a heater lamp such as a halogen lamp. In the embodiment described herein, description will be made on the assumption that the heating unit **33** is configured to include an IH coil. The IH type heating unit **33** has a coil configured to include a magnetic core and a conductive wire wound around the magnetic core. In the configuration example illustrated in FIG. **2**, the heating unit **33** is disposed on the outer periphery of the fixing belt **31**, and the magnetic shunt metal **36** is disposed inside the fixing belt **31** facing the heating unit **33**.

For example, the IH type heating unit **33** is configured to include a plurality of coils as a plurality of heaters. The plurality of coils configuring the heating unit **33** are arranged at a plurality of locations in a width direction of the fixing belt **31**. In the configuration example, the fixing belt **31** may be divided in the width direction into three regions of a central portion, a right side portion, and a left side portion, and a first coil, a second coil, and a third coil may be arranged in the regions, respectively. The first coil heats the central portion including the center in the width direction of the fixing belt **31**. The second and third coils heat both side portions which does not include the center in the width direction of the fixing belt **31**.

The fixing pad **34** is disposed at a position where the fixing belt **31** comes into contact with the press roller **32**. The fixing pad **34** is formed of an elastic body deformed in accordance with the press roller **32** which comes into contact with and is separated from the fixing pad **34**. For example, the fixing pad **34** is formed of foam rubber (sponge). The fixing belt **31** is deformed along with the fixing pad **34**, and forms the nip portion between the fixing belt **31** and the press roller **32** which comes into contact with the fixing pad **34**.

The temperature detector **35** is a sensor which detects the temperature of the fixing belt **31** heated by the heating unit **33**. For example, the temperature detector **35** is the sensor such as a thermistor. The temperature detector **35** may be capable of measuring the temperature of the fixing belt **31**, or may be a thermopile type sensor which detects infrared rays in a non-contact manner. In addition, a plurality of temperature detectors **35** may be set in order to detect the temperature at a plurality of locations in the fixing belt **31**. For example, as the temperature detector **35**, a first temperature sensor for detecting the temperature of the central portion and a second temperature sensor for detecting the temperature of the side portion may be arranged for the fixing belt **31**.

Next, a configuration of the control system of the multi-functional peripheral will be described.

FIG. **3** is a block diagram schematically illustrating a configuration example of the control system in the multi-functional peripheral according to the embodiment.

In the configuration example illustrated in FIG. **3**, the system control unit **5** includes a system CPU (processor) **51**, a RAM **52**, a ROM **53**, a nonvolatile memory (NVM) **54**, an HDD **55**, a page memory **56**, and an external interface (I/F) **58**.

The system CPU **51** integrally controls the entire body and each unit of the whole multi-functional peripheral. The system CPU **51** is a processor which realizes processes by executing a program. The system CPU **51** is connected to each unit in the device via a system bus. The system CPU **51** is connected to not only each unit inside the system control unit **5**, but also the scanner **1**, the printer **2**, the operation panel **4** via the system bus. The system CPU **51** outputs an operation instruction to each of the scanner **1**, the printer **2**, and the operation panel **4**, or acquires various information items from the unit by using bidirectional communication with the unit. In addition, the system CPU **51** inputs information indicating a detection signal and an operation state of various sensors installed in each unit inside the printer **2**.

The RAM **52** is configured to include a volatile memory. The RAM **52** functions as a working memory or a buffer memory. The ROM **53** is a non-rewritable and nonvolatile memory for storing a program and control data. The system CPU **51** realizes various processes by executing the program stored in the ROM **53** (or the nonvolatile memory **54** and the HDD **55**) while using the RAM **52**. For example, the system CPU **51** functions as printing means and printing prohibition means by executing the program.

The nonvolatile memory (NVM) **54** is a rewritable and nonvolatile memory. The NVM **54** stores a control program executed by the system CPU **51** and control data. In addition, the NVM **54** stores various setting information items and processing conditions. For example, the NVM **54** stores the setting information for each sheet feeding cassette (sheet feeding unit). For example, the setting information for the sheet feeding cassette includes flag information indicating whether or not the sheet feeding cassette is a cassette dedicated to the black color.

The hard disk drive (HDD) **55** is a large-capacity storage device. The HDD **55** stores image data and various types of operation history information. In addition, the HDD **55** may store the control program and the control data, or may store the setting information and the processing conditions.

The page memory **56** is a memory for developing the image data serving as a processing target. For example, when a copying process is performed, the page memory **56** stores the image data obtained by the scanner **1** which reads the image and performs image processing on the image for scanning.

The external interface (I/F) **58** is an interface for communicating with an external device. For example, the external interface **58** receives print data in accordance with a print request output from the external device. The external interface **58** may be an interface for communicating with the external device such as a client terminal or a management server. For example, the external interface **58** may be locally connected to the external device, or may be a network interface for communicating with the external device via a network.

Next, a configuration example of the control system in the printer **2** will be described.

In the configuration example illustrated in FIG. **3**, as the configuration of the control system, the printer **2** has a printer CPU (processor) **61**, a RAM **62**, a ROM **63**, a nonvolatile memory (NVM) **64**, and a connector **65**.

The printer CPU **61** controls the overall printer **2**. The printer CPU **61** is a processor which realizes processing by executing a program. The printer CPU **61** is connected to each unit inside the printer **2** via a system bus. In accordance with an operation instruction output from the system CPU **51**, the printer CPU **61** outputs the operation instruction to each unit inside the printer **2**, or notifies the system CPU **51** of various information items acquired from each unit.

The RAM **62** is configured to include a volatile memory. The RAM **62** functions as a working memory or a buffer memory. The ROM **63** is a non-rewritable and nonvolatile memory for storing a program and control data. The printer CPU **61** realizes various processes by executing the program stored in the ROM **63** (or the nonvolatile memory **64**) while using the RAM **62**.

The nonvolatile memory (NVM) **64** is a rewritable and nonvolatile memory. For example, the nonvolatile memory **64** stores a control program and control data which are executed by the printer CPU **61**. In addition, the nonvolatile memory **64** may store setting information and processing conditions.

The conveyance unit **22** is connected to the printer CPU **61**. The printer CPU **61** controls sheet conveyance inside the printer **2**. The printer CPU **61** controls motors for driving the pickup roller **21** and the conveyance unit **22**. In accordance with an operation instruction from the system CPU **51**, the printer CPU **61** controls driving of a conveyance roller of the conveyance unit **22** inside the printer **2**. For example, the printer CPU **61** instructs the pickup roller **21** and the conveyance unit **22** to start sheet feeding in accordance with an instruction to start image formation processing, which is output from the system CPU **51**.

The exposure unit **26** is connected to the printer CPU **61**. The printer CPU **61** controls the exposure unit **26**. The printer CPU **61** causes the exposure unit **26** to form the electrostatic latent image on the photoconductive drum of each of the image forming units **25**Y, **25**M, **25**C, and **25**K. For example, the printer CPU **61** controls laser light with which the exposure unit **26** irradiates each photoconductive drum in accordance with the image data supplied from the system control unit **5**.

The image forming unit **25** is connected to the printer CPU **61**. The printer CPU **61** controls driving of each of the image forming units **25**Y, **25**M, **25**C, and **25**K. The printer CPU **61** develops the electrostatic latent image formed on the photoconductive drum of each of the image forming units **25**Y, **25**M, **25**C, and **25**K by using the toner of each color.

The transfer unit **28** is connected to the printer CPU **61**. The printer CPU **61** controls driving and a transfer current of the transfer unit **28**. The printer CPU **61** causes the transfer unit **28** to transfer the toner image transferred to the intermediate transfer belt **27** to the sheet.

The fixing unit **29** is unitized, and has a harness for being electrically connected to the printer **2**. The connector **65** connects the harness of the unitized fixing unit **29**. The fixing unit **29** is connected to the printer CPU **61** and a power source via the connector **65**. The printer CPU **61** controls driving of the fixing unit **29** connected to the printer CPU **61** via the connector **65**. For example, the printer CPU **61** controls the heating unit **33** to be turned on and off, and controls driving of the fixing belt **31** and the press roller **32**. In addition, the printer CPU **61** has a function to control the contact and separation mechanism by controlling driving of a drive unit **41** (to be described later).

In addition, the printer CPU **61** acquires information indicating the temperature measured by the temperature detector **35** at a preset timing. In the fixing process, the printer CPU **61** acquires the temperature measured by the temperature detector **35** in a sampling period (first period) for temperature control (fixing control). The printer CPU **61** controls the heating unit **33**, based on the temperature acquired in the sampling period for temperature control, thereby controlling surface temperature of the fixing belt **31** to be control target temperature. The printer CPU **61** also has a function to acquire the temperature measured by the temperature detector **35** in a sampling period (second period) for detecting abnormality, which is shorter than the sampling period for temperature control.

In the embodiment described herein, the printer CPU **61** performs the control of the fixing unit **29** including the control of processes described later. However, the processes described later may be performed by the system CPU **51** of the system control unit **5**. In addition, the processes described later may be performed by the processor disposed inside the fixing unit **29**. The processor and the memory for executing the processes described later are disposed inside the fixing unit **29**. In this manner, it is possible to realize the fixing unit **29** having a function to realize the processes described later.

Next, a configuration of the contact and separation mechanism in the fixing unit **29** of the multi-functional peripheral according to the embodiment will be described.

FIG. **4** is a perspective view schematically illustrating a configuration example of the overall fixing unit **29**. FIG. **5** is a view for describing the configuration example of the contact and separation mechanism by which the press roller **32** is brought into contact with or is separated from the fixing belt **31** in the fixing unit **29**.

In the configuration example illustrated in FIGS. **4** and **5**, the contact and separation mechanism is configured to include the drive unit (contact and separation motor) **41**, a shaft **42**, an eccentric cam **43**, and a cam follower **44**.

The drive unit **41** applies a drive force by which the press roller **32** is brought into contact with or is separated from the fixing belt **31**. For example, the drive unit **41** is configured to include a brush motor. The drive unit **41** is driven in accordance with a control instruction output from the system control unit **5**. The drive unit **41** is connected to the shaft **42** serving as a rotation axis of the eccentric cam **43** via a plurality of gears. The shaft **42** is rotated along with the rotation of the motor serving as the drive unit **41**, thereby rotating the eccentric cam **43** disposed in the shaft **42**. The system control unit **5** controls a rotation angle of the eccentric cam **43** by controlling an operation of the drive unit **41**.

The eccentric cam **43** has an eccentric shape, and moves the cam follower **44** by rotating around the shaft **42** serving as the rotation axis. The cam follower **44** moves the press roller **32** in a direction where the press roller **32** is brought into contact with or is separated from the fixing belt **31**. The cam follower **44** is connected to a spring (elastic body) **45**, and is configured to be always in contact with the rotating eccentric cam **43**. The cam follower **44** moves along with the rotation of the eccentric cam **43**, thereby causing the press roller **32** to move in the direction the press roller **32** is brought into contact with or is separated from the fixing belt **31**.

As illustrated in FIG. **4**, the eccentric cam **43** and the cam follower **44** are respectively disposed in both ends of the press roller **32**. The two eccentric cams **43** disposed in both ends of the press roller **32** have the same shape. In addition, the two cam followers **44** disposed in both ends of the press roller **32** also have the same shape. In each end of the press roller **32**, the eccentric cam **43** and the cam follower **44** are disposed so as to come into contact with each other.

The two eccentric cams **43** disposed in both ends of the press roller **32** are connected to each other by the shaft **42**. The two eccentric cam **43** (in both ends) are similarly rotated in accordance with the rotation of the shaft **42**. That is, the two eccentric cams **43** connected to the shaft **42** rotated by the drive unit **41** are rotated at the same time. The two eccentric cams **43** connected to the shaft **42** are rotated, thereby causing the two cam followers **44** to move both ends of the press roller **32**.

In the example illustrated in FIG. **5**, if a contact portion with the eccentric cam **43** is pushed in a direction of an arrow a, the cam follower **44** moves the press roller **32** in a direction of an arrow b. In other words, if the eccentric cam **43** moves the contact portion with the cam follower **44** in the direction of the arrow a, the press roller **32** moves in the direction (direction of the arrow b) where the press roller **32** comes into contact with the fixing belt **31**. As the eccentric cam **43** moves the cam follower **44** in the direction of the arrow a after the press roller **32** and the fixing belt **31** come into contact with each other, the pressure (nipping pressure) applied to the nip portion between the press roller **32** and the fixing belt **31** increases.

In addition, if the contact portion with the eccentric cam **43** moves in a direction opposite to the arrow a, the cam follower **44** moves the press roller **32** in a direction opposite to the arrow b. In other words, if the eccentric cam **43** moves the cam follower **44** in the direction opposite to the arrow a, the press roller **32** moves in the direction separated from the fixing belt **31**. In a state where the press roller **32** and the fixing belt **31** are in contact with each other, as the eccentric cam **43** moves the cam follower **44** in the direction opposite to the arrow a, the nipping pressure decreases. In addition, in a separated state, as the eccentric cam **43** moves the cam follower **44** in the direction opposite to the arrow a, the distance between the press roller **32** and the fixing belt **31** becomes wider.

Next, a relationship between a rotation angle of the eccentric cam **43** and a position of the press roller **32** in the fixing unit **29** will be described.

FIG. **6** is a view illustrating an example of the relationship between the rotation angle of the eccentric cam **43** and the position of the press roller **32** in the fixing unit **29** according to the embodiment.

The fixing unit **29** causes the heating unit **33** to heat the fixing belt **31** up to the fixing temperature, and causes the printing medium to pass through the nip portion between the fixing belt **31** and the press roller **32**. The toner on the printing medium passing through the nip portion is fixed onto the printing medium by the heat and the nipping pressure. The fixing unit **29** adjusts the nip portion by moving the press roller **32** in accordance with the fixing process.

For example, the press roller **32** can set a separation position, a contact position, and an envelope position for the fixing belt **31**. The separation position is a position when the press roller **32** and the fixing belt **31** are separated from each other. The contact position is a position when the fixing process is performed on a sheet having a thickness equal to or smaller than a predetermined threshold value (hereinafter, simply referred to as a sheet). The envelope position is a position when the fixing process is performed on an envelope, that is, a sheet having a thickness larger than the predetermined threshold value.

In the example illustrated in FIG. **6**, if the rotation angle of the eccentric cam **43** is 320° to 40°, the press roller **32** and the fixing belt **31** are in the separated state. In addition, if the rotation angle of the eccentric cam **43** is 0°, the press roller **32** is located at the separation position with respect to the fixing belt **31**. The multi-functional peripheral sets the rotation angle of the eccentric cam **43** to 0° when the press roller **32** is located at the separation position.

In the example illustrated in FIG. **6**, if the rotation angle of the eccentric cam **43** is 194° to 244°, the press roller **32** and the fixing belt **31** form the nip portion suitable for the fixing process of the sheet. In addition, when the rotation angle of the eccentric cam **43** is 219°, the press roller **32** is located at the contact position with respect to the fixing belt **31**. For example, when the fixing process is performed on the sheet, the eccentric cam **43** is rotated from 0° to 219° in order to move the press roller **32** from the separation position to the contact position.

In the example illustrated in FIG. **6**, if the rotation angle of the eccentric cam **43** is 80° to 128°, the press roller **32** and the fixing belt **31** form the nip portion suitable for the fixing process for the envelope. In addition, when the rotation angle of the eccentric cam **43** is 104°, the press roller **32** is located at the envelope position with respect to the fixing belt **31**. In addition, when the fixing process is performed on the envelope, the eccentric cam **43** is rotated from 0° to 104° in order to move the press roller **32** from the separation position to the envelope position.

In addition, when the fixing process is completed, the eccentric cam **43** is rotated from 219° or 104° to 0° in order to move the press roller **32** from the contact position or the envelope position to the separation position.

Next, operation control of each unit in the fixing unit **29** will be described.

FIGS. **7** and **8** are timing charts for describing the operation of the units associated with the fixing process in the fixing unit **29** of the multi-functional peripheral according to the embodiment.

In the example illustrated in FIG. **7**, the fixing unit **29** has a sensor which detects that the position of the eccentric cam **43** is between 80° and 320°. In addition, in the example illustrated in FIG. **8**, the fixing unit **29** has a first sensor which detects that the position of the eccentric cam **43** is between 80° and 180°, and a second sensor which detects that the position of the eccentric cam **43** is between 130° and 320°. In the charts illustrated in FIGS. **7** and **8**, in an initial state, the eccentric cam **43** is located at the separation position where the rotation angle is 0°.

If the fixing process starts, the printer CPU **61** turns on the contact and separation motor serving as the drive unit **41**, thereby rotating the eccentric cam **43**. If the motor of the drive unit **41** is turned on, the eccentric cam **43** starts to be rotated. In addition, the eccentric cam **43** is braked in rotation if the motor of the drive unit **41** is turned off. In this manner, the eccentric cam **43** stops when a stop time P**0** elapses after the motor of the drive unit **41** is turned off.

In the example illustrated in FIG. **7**, if the press roller **32** is located at the contact position (when the fixing process is performed on the sheet), when a first time P**1** elapses after the rotation angle of the eccentric cam **43** becomes 80°, the motor of the drive unit **41** is turned off. In such a manner that the motor of the drive unit **41** is turned off when the first time P**1** elapses after the rotation angle becomes 80°, the eccentric cam **43** stops at the rotation angle of 219° which represents the contact position.

In addition, in the example illustrated in FIG. **8**, if the press roller **32** is located at the contact position (when the fixing process is performed on the sheet), the motor of the drive unit **41** is turned off when a fourth time P**4** elapses after the rotation angle of the eccentric cam **43** becomes 180°. In such a manner that the motor of the drive unit **41** is turned off when the fourth time P**4** elapses after the rotation angle becomes 180°, the eccentric cam **43** stops at the rotation angle of 219° which represents the contact position. The fixing unit **29** performs the fixing process on the sheet in a state where the press roller **32** is located at the contact position.

In addition, if the press roller **32** is located at the envelope position (if the fixing process is performed on the envelope), the motor of the drive unit **41** is turned off when the second time P**2** elapses after the rotation angle of the eccentric cam **43** becomes 80°. When the stop time P**0** elapses after the motor of the drive unit **41** is turned off at the rotation angle of 80°, the eccentric cam **43** stops at the rotation angle of 104° which represents the envelope position. The fixing process is performed on the envelope at the envelope position.

In addition, when the press roller **32** is located at the separation position, the motor of the drive unit **41** is turned off when a third time P**3** elapses after the rotation angle of the eccentric cam **43** becomes 320°. When the stop time P**0** elapses after the motor of the drive unit **41** is turned off at the rotation angle of 320°, the eccentric cam **43** stops at the rotation angle of 0 (360°) which represents the envelope position.

Next, an operation of the temperature measurement in the fixing process and the abnormality detection process of the fixing unit **29** will be described.

FIG. **9** is a view for describing an operation example of the temperature measurement in the fixing process and the abnormality detection process of the fixing unit **29**.

In the fixing process, the printer CPU **61** acquires information indicating the temperature measured by the temperature detector **35** at the set measurement interval (sampling period for temperature control (first period)). In addition, in the fixing process, the printer CPU **61** acquires the temperature information obtained by averaging the temperatures measured at a predetermined measurement interval in order to perform the temperature control by using stable temperature information. For example, the printer CPU **61** adopts as the averaged temperature information the average values of the temperature values obtained by eliminating the maximum value and the minimum value from a plurality of temperature values acquired in the sampling period for temperature control at each predetermined time.

As described above, the fixing unit **29** is unitized, and the harness of the electrical system is connected to the main body of the multi-functional peripheral via the connector **65**. If the connection in the connector **65** is loose, the connection state of the fixing unit **29** in the connector **65** becomes unstable due to vibrations. For example, if the connection state in the connector **65** becomes unstable due to the vibrations, the fixing unit **29** may have suddenly fluctuating temperature. Therefore, the fixing unit **29** according to the embodiment described herein performs an abnormality detection process for detecting a sudden abnormal change in the temperature.

That is, the fixing unit **29** according to the embodiment described herein performs the abnormality detection process for detecting a sudden temperature change in addition to the temperature measurement in the fixing process. In the abnormality detection process, the fixing unit **29** measures the temperature in the sampling period for abnormality detection (second period) which is shorter than the sampling period (sampling period for temperature control) used for the temperature measurement in the fixing process. For example, in the example illustrated in FIG. **9**, the sampling period for temperature control is 50 msec, and the sampling period for abnormality detection is 5 msec.

In addition, if it is assumed that the connection state becomes unstable due to the vibrations, the abnormality detection process may be performed during a period in which the vibrations are generated. For example, the fixing unit **29** using the above-described mechanism is greatly vibrated when the press roller **32** is brought into contact with or is separated from the fixing belt **31**. Therefore, the fixing unit **29** according to the embodiment described herein performs the abnormality detection process while the operation is performed in which the press roller **32** is brought into contact with or is separated from the fixing belt **31**.

According to the above-described mechanism, it is expected that the fixing unit **29** is greatly vibrated when the press roller **32** is separated from the fixing belt **31**. Therefore, the abnormality detection process may be performed during the operation of the press roller **32** separating from the fixing belt **31**. In the multi-functional peripheral in which the vibrations are generated due to the operation other than contact or separation, the abnormality detection process may be performed during a period in which the vibrations are generated.

Next, an operation including the abnormality detection process in the fixing unit **29** of the multi-functional peripheral will be described.

First, a process of setting the timing of measuring the temperature in the fixing unit **29** (sampling period setting process) will be described.

FIG. **10** is a flowchart for describing the sampling period setting process (measurement setting process) for setting the timing of measuring the temperature in the fixing unit **29**.

Here, the printer CPU **61** performs the abnormality detection process while the drive unit (contact and separation motor) **41** is driven in the contact and separation mechanism. In this case, the printer CPU **61** sets the timing (sampling period) of acquiring the temperature measured by the temperature detector **35** in accordance with the driving of the drive unit (contact and separation motor) **41** in the contact and separation mechanism. That is, the printer CPU **61** monitors whether or not the drive unit **41** is driven during the period in which the temperature control of the fixing unit **29** is performed (ACT**11**).

When it is determined that the drive unit **41** is not driven (ACT**11**, NO), the printer CPU **61** sets the timing of acquiring the temperature from the temperature detector **35** to the sampling period for temperature control (the first period) (ACT**12**). For example, if the sampling period for temperature control is 50 msec, the printer CPU **61** sets the timing so as to acquire the temperature measured by the temperature detector **35** at a period of 50 msec.

When it is determined that the drive unit **41** is driven (ACT**11**, YES), the printer CPU **61** sets the timing of acquiring the temperature from the temperature detector **35** to the sampling period for abnormality detection (the second period) (ACT**13**). For example, if the sampling period for abnormality detection is 5 msec, the printer CPU **61** sets the timing so as to acquire the temperature measured by the temperature detector **35** at a period of 5 msec.

As described above, the multi-functional peripheral sets the sampling period for acquiring the temperature information depending on whether or not to perform the abnormality detection process. In the embodiment described herein, on the assumption that the vibrations are generated during the contact operation or the separation operation, the fixing unit **29** performs the abnormality detection process during the contact operation or the separation operation. Therefore, the multi-functional peripheral sets the sampling period of the temperature depending on whether or not the drive unit **41** of the contact and separation mechanism is driven. In this manner, the multi-functional peripheral can perform the abnormality detection process during a period when the vibrations are generated due to the operation of the fixing unit **29** which comes into contact with or is separated from the press roller **32**.

Next, the sampling process (temperature measurement process) of the temperature in the fixing unit **29** will be described.

FIG. **11** is a flowchart for describing the sampling process (temperature measurement process) of the temperature in the fixing unit **29**.

Here, the printer CPU **61** repeatedly performs the sampling process illustrated in FIG. **12** at a predetermined period (for example, 1 msec). The predetermined period for performing the sampling process at the temperature illustrated in FIG. **12** may be shorter than the sampling period for abnormality detection.

The printer CPU **61** updates a counter disposed in the RAM **62** at each predetermined period (ACT**21**). The counter records the elapsed time. For example, if the operation period is 1 msec, the printer CPU **61** increments a value of the counter every 1 msec. In this manner, the counter has a value indicating the elapsed time.

If the counter is updated, the printer CPU **61** determines whether or not the abnormality detection process is in progress (ACT**22**). For example, if the abnormality detection process is performed while the drive unit **41** is driven, the printer CPU **61** determines whether or not the drive unit **41** is driven. If it is determined that the abnormality detection process is in progress (ACT**22**, YES), the printer CPU **61** determines whether the current period is the sampling period for abnormality detection (ACT**23**).

When it is determined that the current period is the sampling period for abnormality detection (ACT**23**, YES), the printer CPU **61** acquires the information (temperature information) indicating the temperature measured by the temperature detector **35** (ACT**24**). If the temperature information is acquired, the printer CPU **61** stores the obtained temperature information in an abnormality detecting buffer (ACT**25**). The abnormality detecting buffer may be disposed in either the volatile memory such as the RAM **52** and the RAM **62** or the nonvolatile memory such as the NVM **54**, the NVM **64**, and the HDD **55**. For example, if the sampled temperature information is stored all in the nonvolatile memory, there is a possibility that storage capacity may be insufficient. Accordingly, the sampled temperature information is stored in volatile memory. The nonvolatile memory may store the information (buffer content) stored in volatile memory when an error (to be described later) is detected, as a log at the time of error detection.

If the temperature information is stored in the abnormality detecting buffer, the printer CPU **61** determines whether or not to perform a process of confirming the presence or absence of abnormality (abnormality confirmation process) (ACT**26**). The abnormality confirmation process is performed at preset timing. For example, the abnormality confirmation process may be performed at an abnormality checking period (for example, every 50 msec) as a preset period.

When it is determined to perform the abnormality confirmation process (ACT**26**, YES), the printer CPU **61** performs the abnormality confirmation process, based on the temperature information stored in the abnormality detecting buffer (ACT**27**). The abnormality confirmation process will be described in detail later.

When it is determined that the current period is not the sampling period for abnormality detection (ACT**23**, NO), if it is determined that the abnormality confirmation process does not need to be performed (ACT**26**, NO) or if the abnormality confirmation process is performed (ACT**26**), the printer CPU **61** determines whether or not the current period is the sampling period for temperature control (ACT**28**).

When the current period is the sampling period for temperature control (ACT**28**, YES), the printer CPU **61** acquires the information (temperature information) indicating the temperature measured by the temperature detector **35** (ACT**29**). If the temperature information is acquired in the sampling period for temperature control, the printer CPU **61** stores the acquired temperature information in a temperature controlling buffer (ACT**30**). The temperature controlling buffer is disposed in the volatile memory such as the RAM **52** and the RAM **62**. However, the temperature controlling buffer may be disposed in the nonvolatile memory such as the NVM **54**, the NVM **64**, and the HDD **55**.

If the temperature information is stored in the temperature controlling buffer, the printer CPU **61** averages the temperature information items stored in the temperature controlling buffer for every predetermined number (for example, 5) of the temperature information items (a plurality of temperature information items measured in a predetermined time) (ACT**31**). The printer CPU **61** controls the temperature inside the fixing unit **29** by controlling the heating unit **33** to be turned on and off, based on the averaged temperature information.

According to the above-described process, when the abnormality detection process is in progress, separately from the temperature information for temperature control, the multi-functional peripheral acquires the temperature information for abnormality detection in the sampling period for abnormality detection. In addition, the multi-functional peripheral stores the temperature information acquired in the sampling period for abnormality detection in the abnormality detecting buffer. In this manner, the multi-functional peripheral can confirm the presence or absence of abnormality by using the temperature information stored in the abnormality detecting buffer.

Next, the abnormality confirmation process for the fixing unit **29** will be described.

FIG. **12** is a flowchart for describing an operation example of the abnormality confirmation process for the fixing unit **29**.

When the abnormality confirmation process is performed, the printer CPU **61** reads one of the temperature information items (abnormality detecting temperature values) stored in the abnormality detecting buffer (ACT**41**). If the abnormality detecting temperature value is read, the printer CPU **61** determines whether the read temperature value is an abnormal value (ACT**42**). The printer CPU **61** compares the read temperature value with the value of the temperature control when the temperature value is measured, and determines whether or not the read temperature value is the abnormal value.

For example, the value compared with the read temperature value is a temperature value obtained by averaging the temperature values for temperature control in a period including the time during which the temperature value is measured. In this case, the printer CPU **61** specifies the temperature value obtained by averaging the temperature values for temperature control in the period including the time during which the temperature value is measured. The printer CPU **61** calculates a difference between the specified temperature value obtained through averaging and the temperature value, and determines whether or not the read temperature value is the abnormal value, based on whether or not the calculated difference exceeds an abnormality determining threshold value.

In addition, the value compared with the read temperature value may be the temperature value for temperature control measured before and after the temperature value is measured. In this case, the printer CPU **61** specifies the temperature value for temperature control measured before and after the temperature value is measured. The printer CPU **61** calculates a difference between the specified temperature value for temperature control and the temperature value, and determines whether or not the read temperature value is the abnormal value, based on whether or not the calculated difference exceeds the abnormality determining threshold value.

In addition, the value compared with the read temperature value may be a temperature value (fixing temperature) of a control target in the temperature control when the temperature value is measured. In this case, the printer CPU **61** specifies the temperature value of the control target in the temperature control when the temperature value is measured. The printer CPU **61** calculates a difference between the temperature value of the control target in the temperature control and the temperature value, and determines whether or not the read temperature value is the abnormal value, based on whether or not the calculated difference exceeds an abnormality determining threshold value.

For example, FIG. **13** is a view illustrating an example of the abnormality detecting temperature value stored in the abnormality detecting buffer.

In FIG. **13**, the sampling period for abnormality detection is set to 5 msec, and the sampling period for temperature control is set to 50 msec. In this case, in one period of the sampling period (50 msec) for temperature control, 10 temperature values are measured in the sampling period (5 msec) for abnormality detection.

In the example illustrated in FIG. **13**, the temperature value (temperature value obtained through averaging) for temperature control which is measured in the sampling period for temperature control is set to 151° C. In this case, the printer CPU **61** determines whether or not the read temperature value is the abnormal value, based on a difference between each temperature value for abnormality detection and 151° C. serving as the temperature value for temperature control. If the threshold value for abnormality determination with respect to the difference is 10° C., it is determined that the temperature values 165° C. and 136° C. illustrated in FIG. **13** are the abnormal values.

When it is determined that the read temperature value is the abnormal value (ACT**42**, YES), the printer CPU **61** increments the abnormality counter (ACT**43**). For example, the abnormality counter is disposed in the RAM **62**. In addition, the abnormality counter may be disposed in the NVM **63**, or may be disposed in the RAM **52**, the NVM **54**, or the HDD **55**.

The printer CPU **61** performs the processes in ACT**41** to ACT**43** for each temperature value until it is completely determined whether or not each temperature value stored in the abnormality detecting buffer is the abnormal value (ACT**44**, NO). If the printer CPU **61** completely confirms whether or not each temperature value stored in the abnormality detecting buffer is the abnormal value (ACT**44**, YES), the printer CPU **61** determines whether the value of the abnormality counter is a value regarded as an error (ACT**45**).

For example, the printer CPU **61** determines whether the value of the abnormality counter (the number of times that the abnormal value is detected) is equal to or greater than an error determining threshold value (the predetermined number of times that the value is regarded as the error). There is a possibility that the output of the temperature detector **35** may actually include noise due to implementation. Therefore, there is a possibility that the temperature value determined as the abnormal value is caused by the noise. Therefore, by determining that the temperature value is an error when the number of times that the abnormal value is detected is equal to or more than the predetermined number of times, the influence of the noise in the temperature detector **35** can be reduced.

When it is determined that the value of the abnormality counter is equal to or greater than the error determining threshold value (the predetermined number of times) (ACT**45**, YES), the printer CPU **61** performs an error process (ACT**46** to ACT**48**). The content of the error process performed when an error is detected in the temperature of the fixing unit **29** can be appropriately set depending on an operation mode.

For example, as the error process, the printer CPU **61** stores the temperature information determined as the error, in the NVM **63** as an error log (ACT**46**). The information as the error log of the temperature information determined as the error may be stored in the NVM **54** or the HDD **55** of the system control unit **5**.

In addition, as the error process, the printer CPU **61** causes the display unit **4***a* of the operation panel **4** to display that the abnormal value is detected in the temperature of the fixing unit **29** (ACT**48**). In this case, the printer CPU **61** may cause the display unit **4***a* to display that there is a possibility of poor connection of the fixing unit **29** (poor coupling of the harness). In addition, when the display unit **4***a* displays that abnormality is detected, the printer CPU **61** may cause the display unit **4***a* to display the temperature information stored in the abnormality detecting buffer.

In addition, as the error process, the printer CPU **61** notifies an external device (for example, a management server) that the abnormal value is detected in the temperature of the fixing unit **29** (ACT**47**). In this case, the printer CPU **61** notifies the management server that the abnormality is detected, via the external interface **58** of the system control unit **5**. In addition, the printer CPU **61** may notify the external device that there is a possibility of poor connection of the fixing unit **29**. In addition, when the printer CPU **61** gives notification of the fact that abnormality is detected, the printer CPU **61** may transmit the information such as the temperature information stored in the abnormality detecting buffer to the external device.

The above-described process is not limited to detecting abnormality of the fixing unit **29** during the operation of the multi-functional peripheral. For example, the multi-functional peripheral may perform the above-described process in a mode (initial abnormality check mode) when the multi-functional peripheral is manufactured and assembled after the fixing unit **29** is attached thereto. In this manner, the multi-functional peripheral can detect initial abnormality caused by poor attachment of the fixing unit **29** when the multi-functional peripheral is assembled as a product (manufacturing process including the attachment of the fixing unit **29**).

Furthermore, as the error process in the mode when the multi-functional peripheral is manufactured and assembled, the multi-functional peripheral may not store the error log or may not notify the external device of the error log, but may cause the display unit **4***a* to display the abnormality. In this manner, when the multi-functional peripheral is manufactured and assembled, the worker can easily recognize the abnormality caused by poor attachment of the fixing unit **29**, based on the display content of the display unit **4***a*.

As the error process in the operation mode (operation mode other than the mode when the multi-functional peripheral is manufactured and assembled) when the multi-functional peripheral is operated by a user, the multi-functional peripheral may not cause the display unit **4***a* to display the abnormality, but store the error log, or notify the external device of the error log. In this manner, when the multi-functional peripheral is operated by the user, the multi-functional peripheral may not positively notify the user that there is a possibility of abnormality (possibility of abnormality for which the actual fixing process does not need to be immediately stopped), but a serviceman or the management server can efficiently perform maintenance on the poor attachment of the fixing unit **29**.

As described above, the multi-functional peripheral according to the embodiment can easily determine the possibility of abnormality which is less likely to be found in the temperature measurement in the normal fixing process. As a result, it is possible to detect the abnormality of the fixing unit **29** at an early stage even when the product is assembled or is operated by the user, and problems caused by breakage of a fixing unit can be prevented in advance. In addition, the temperature information measured in the period shorter than that of the normal temperature measurement is stored as the error log, or notification of the error log is given to the external device. In this manner, it is possible to easily analyze problems in the case where the problems actually occur.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of invention. Indeed, the novel apparatus and methods described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the apparatus and methods described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. An image forming apparatus, comprising:
- an image forming unit configured to form an image using an image forming material;
- a fixing unit configured to heat the image forming material on a medium;
- a sensor that detects a temperature of the fixing unit; and
- a processor configured to control the fixing unit based on the temperature detected by the sensor in a first time period, and a temperature detected by the sensor in a second time period shorter than the first time period.

2. The apparatus according to claim **1**,
- wherein the fixing unit includes a fixing member and a press roller.

3. The apparatus according to claim **2**, further comprising:
- a contact and separation mechanism that causes the fixing member and the press roller to come into contact with or to separate from each other,
- wherein the processor is configured to detect the temperature in the second time period while the contact and separation mechanism is driven.

4. The apparatus according to claim **1**,
- wherein when the processor determines that the temperature in the second time period is an abnormal value, the processor outputs a signal notifying if the abnormal value occurs.

5. The apparatus according to claim **4**,
- wherein when a number of times when a difference between the temperature in the second time period and temperatures in the first time period is greater than a predetermined threshold value is more than a predetermined number of times, the processor determines that the temperature in the second time period is the abnormal value.

6. The apparatus according to claim **4**, further comprising:
- a display unit for displaying that the abnormal value occurs, in accordance with the signal output by the processor.

7. The apparatus according to claim **4**, further comprising:
- a communication interface that communicates with an external device,
- wherein when the processor determines that the temperature in the second time period is the abnormal value, the processor transmits the signal notifying if the abnormal value occurs, to the external device.

8. The apparatus according to claim 1,

wherein the fixing unit includes an electromagnetic induction heater.

9. The apparatus according to claim 1,

wherein the second time period is shorter than the first time period.

10. The apparatus according to claim 1,

wherein the second time period is a tenth shorter than the first time period.

11. An image forming method, comprising:

forming an image using an image forming material;

heating the image forming material on a medium using a fixing unit;

detecting a temperature of the fixing unit; and

controlling the fixing unit based on a temperature detected in a first time period, and a temperature detected in a second time period shorter than the first time period.

12. The method according to claim 11, further comprising:

heating the image forming material using a fixing member and a press roller.

13. The method according to claim 12, further comprising:

causing the fixing member and the press roller to come into contact with or to separate from each other; and

detecting the temperature in the second time period while causing the fixing member and the press roller to come into contact with or to separate from each other.

14. The method according to claim 11, further comprising:

determining whether the temperature in the second time period is an abnormal value; and

outputting a signal notifying if the abnormal value occurs.

15. The method according to claim 14, further comprising:

when a number of times when a difference between the temperature in the second time period and the temperatures in the first time period is greater than a predetermined threshold value is more than a predetermined number of times, determining whether the temperature in the second time period is the abnormal value.

16. The method according to claim 14, further comprising:

displaying that the abnormal value occurs, in accordance with the signal output.

17. The method according to claim 14, further comprising:

communicating with an external device;

determining whether the temperature in the second time period is the abnormal value; and

transmitting the signal notifying if the abnormal value occurs to the external device.

18. The method according to claim 11,

wherein heating the image forming material comprises using an electromagnetic induction heater.

19. The method according to claim 11,

wherein the second time period is shorter than the first time period.

20. The method according to claim 11,

wherein the second time period is a tenth shorter than the first time period.

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